RAPTOR RESEARCH NEWS

Volume 4
Numbers one through six
January - December, 1970

RAPTOR RESEARCH FOUNDATION, INC.

RAPTOR RESEARCH NEWS

Volume 4

Number 1

January-February 1970

Editors: Byron E. Harrell; Donald V. Hunter, Jr.

The *Raptor Research News* is designed as an informal information exchange. Contributions are edited, but are not usually submitted for refereeing as in formal scientific journals of record. Some of the items are progress reports or expressions of ideas to stimulate discussion; thus citations of contents of the *News* should be avoided unless approval is received from the author.

NOTES, NEWS, AND QUERIES 2
New Format of News 2
Renewals 2
Editors' Acknowledgments 2
Raptor Research Abstracts 2
White-tailed Sea Eagle Breeding in Captivity 3
Giant Steps Away From DDT 3
Endangered Species Bill 4
Eagles in Lakeland 5
In Danger in Europe 5
Germans Pillage Italy 5
Sea Eagles in Iceland 5
Raptor Laws of United States and Canada 5
Basic References in Comparative Endocrinology 6
Predation Theory 6
Pesticide Series 6
Corrections 7
RAPTOR RESEARCH SURVEY: 1970 No. 1 8
HEALING OF A SHATTERED WING IN A GYRFALCON (John Lejeune) 14
CAPTIVE BREEDING BEHAVIOR--AMERICAN GOSHAWK--PART 2 (Robert B. Berry) 18

RAPTOR RESEARCH FOUNDATION, INC.
c/o Biology Department
University of South Dakota
Vermillion, South Dakota 57069 U.S.A.

NOTES, NEWS, AND QUERIES

New Format of News. We have been fortunate to be able to have copy for offsetting set up in justified type on an IBM Selectric Composer. The extra cost is largely made up by reduced printing costs since more material appears on a sheet. Mailing without envelopes further reduces costs.

Renewals. We are happy to report that many renewals have been coming in. This issue is being sent to all members of last year with this notice as our invitation to stay with us; if you have not yet paid 1970 contributions, a 70 will be missing from your address label. All new and old members will receive a summary of the Cornell conference and a title page and index for volumes 1 to 3 soon.

Editors' Acknowledgments. In addition to our contributors we want to thank Fran Hamerstrom who kindly read through Part 2 of Berry's paper and provided many useful suggestions and to Lee Eberly who prepared the final copy of the line drawings in the Berry and in the Lejeune papers and helped in many other ways.

Raptor Research Abstracts. The Board of Directors of the Raptor Research Foundation has approved the initiation of an abstracting service covering publications on hawks and owls. Some of the reasons for investing the money and effort in this project are: the literature is very scattered and world wide; much material appears in local or regional journals often not abstracted; many abstracts of faunal papers and books do not indicate the nature of the material presented on our species; the material can be indexed better for the raptor worker than it is in more general services; literature searches can be speeded up enormously; many of our members do not have ready access to good research libraries.

These and other values can be realized if we can provide prompt intensive reviews based on an extensive survey of potential sources more inclusive and more directly pertinent to raptors than existing bibliographic services. We also intend to include some additional papers not specifically on raptors such as those on predation theory, or on ecologically similar birds such as skuas and shrikes. We believe there are enough volunteers to keep the work realistic in relation to the number of potentially includable papers.

The organizing of the abstracting will be based on assignments to the cooperators of specific journals and other sources for searching and abstracting papers found. The abstracts and index information will be entered on forms which will aid the preparation of copy for printing and of punch cards for indexing. If the abstracting load is kept low enough, the completed forms can be sent promptly to the R.R.F. office where they can be edited and prepared for offsetting, and the monthly issues assembled and mailed. The index items can be put on punch cards which at the end of the year can be used by the computer to print out the index ready for offsetting.

Material published in 1970 will be used to initiate the series. The first issue should be ready in April or May. Those who indicated an interest in this type of work on their questionnaires will receive invitations to be cooperators in the near future. Anyone else who may wish to help is encouraged to write to the R.R.F. office.

White-tailed Sea Eagle Breeding in Captivity. Sergej Postupalsky writes,

> "White-tailed sea eagles (*Haliaeetus albicilla*) have bred successfully in the Schönbrunn Zoo in Vienna, Austria, since 1961, according to an article by Walter Fiedler in the December 1969 issue of Vogelkosmos (publ. by Kosmos Verlag, Stuttgart, West Germany). One young each was raised in 1961-1967, young one died in 1968, two young raised in 1969. The adults were obtained in 1955 when still in immature plumage. Patuxent Research Center, which now has over a dozen bald eagles ought to get on the ball and try breeding them. It can be done!"

Giant Steps Away From DDT. On November 20 Agriculture Secretary Clifford Hardin announced that within 30 days the use of DDT would be eliminated in control of shade tree pests, pests in aquatic areas, house and garden pests and tobacco pests. This action will curtail about 35% of the DDT currently used annually in the United States.

Hardin also called for cancellation of all other DDT uses by December 31, 1970, excepting essential cases where there is no alternative to DDT. Similar action on other persistent pesticides is scheduled to begin March 1970.

The Secretary's announcements came in wake of the latest in a long line of objective indictments of DDT prepared by the Health, Education and Welfare Department's Commission on Pesticides and Their Relationship to Environmental Health headed by Dr. Emil M.

Mrak, Chancellor Emeritus of the University of California at Davis.

HEW Secretary Finch appointed the Mrak Commission last April after the Food and Drug Administration seized several thousand pounds of Lake Michigan coho salmon containing extremely high DDT levels enroute to family dinner tables.

The Commission's report offered few revelations on the environmental threat of DDT. It essentially echoed the theme of many previous recommendations in that "The uses of DDT. . .should be limited to the prevention or control of human disease and other essential uses for which no alternative is available. Such uses should be clearly identified and individually evaluated in relation to human hazard from exposure, movement in the natural environment, concentration in the food chains of the world and other environmental considerations."

The Report did suggest, "Unanimous approval by the Secretaries of HEW, Agriculture and Interior would provide for identification of essential uses and assure that such approval will be based upon sound judgment." This recommendation has apparently been implemented, much to the delight of conservationists who've historically been less than ecstatic with the Agriculture Department's activities aimed at protecting the environment from the side effects of persistent pesticides.

Certainly these are the first giant steps toward purging neanderthal pest control from the space age. But it isn't yet time to compose a dirge for DDT.

In recent years most of the DDT manufactured in the United States has been exported, and these latest actions have little or no effect on that major American contribution to world-wide DDT contamination. Provincial regulations are of little consequence to a poison that knows no boundaries. Continued use of DDT, even in the world's remotest corners, is and will continue to be a threat to Everyman despite these first giant steps. (Reprinted from *Conservation News* 34(23):2, Dec. 1, 1969).

Endangered Species Bill. The "Endangered Species" bill (H.R. 11363) was signed into Public Law 91-135 by the President on December 5, 1969.

The law prevents the importation into the U. S. of endangered species of wildlife or their parts. Strengthening the program to protect domestic species of endangered wildlife by authorizing added monies, the law gives added protection to such domestic wildlife as alligators. Conservationists generally regard the law as the most important wildlife conservation legislation to be passed by Congress this year. (Reprinted from *Conservation News* 35(1):3, Jan. 1, 1970).

Eagles in Lakeland. Golden Eagles have nested in the Lake District [British Isles] for the first time for 200 years, but unfortunately they deserted the nest with two eggs. (From *Kingfisher* 4(6):7, July-Aug. 1969).

In Danger in Europe. The Council for Europe has recently published a list of 25 birds regarded as in danger in Europe; the white and Dalmatian pelicans, pigmy cormorant, spoonbill, glossy ibis, flamingo, white-headed duck, black vulture, lammergeyer, black-winged kite, peregrine and lanner falcons, purple gallinule, demoiselle crane, great bustard, Audouin's gull, little auk, eagle-owl and four species of eagle—imperial, tawny, Bonelli's and white-tailed (sea). Those considered to be in the gravest danger are the Dalmatian pelican, flamingo, white-headed duck and lammergeyer. (*Courrier de la Nature*, 1/1969) (From *Kingfisher* 4(6):10, July-Aug. 1969).

Germans Pillage Italy. A group of German nest-robbers were caught in the act at a peregrine's nest at Gaeta, Italy on April 13. They declared they were going on to Sardinia to rob the nests of ravens and of the last surviving pair of lammergeiers in the island. A fortnight later another group of Germans were similarly caught near Sapri (salerno). They were forced by the police to replace the peregrine nestlings they had just taken, but at dawn the next day they were caught trying to remove them again. These and other groups of nest-robbers travel round the country taking the young of birds of prey, and even eggs, which they put in incubators, with the aim of rearing them for falconry. (Italian National Appeal, WWF). (From *Kingfisher* 4(6):10, July-Aug. 1969).

Sea Eagles in Iceland. The number of white-tailed or sea eagles in Iceland, which was at a very low ebb in Iceland five years ago, due to poison spread for foxes, is now steadily rising, and has reached an estimated 40. (From *Kingfisher* 4(6):10, July-Aug. 1969).

Raptor Laws of United States and Canada. The January issue of *California Condor*, the newsletter of the Society for the Preservation of Birds of Prey has a report of a survey by states and provinces. The laws are varied and all but a few (Montana, New Mexico, and South Carolina) protect some raptors. Of more significance might be a survey of game wardens and their attitudes which in some cases is unrelated to the coverages of the laws.

Another feature of this survey is an attempt to list the number of

falconry licenses. Unfortunately the data are inadequate to evaluate the level of activity of this sport. For example it is not clear whether the numbers apply to residents or brief visitors. It is also not clear how many of these represent a bird or not or whether more than one or whether it involves birds held from previous years or for acquisitions of that year. Since many different species are kept it is impossible to have any idea of how many of each species are held, or captured in a given year, or for that matter whether exotics are included. I suspect that even if one asked the authorities the right questions all of the desirable information would not usually be available from such sources. Discussions of the impact of falconers on raptor populations usually provide more heat than light. Realistic data would be desirable, but data collection would, unfortunately, have to be more sophisticated than a questionnaire to wildlife agencies.

Basic References in Comparative Endocrinology. Prof. A. van Tienhoven has annotated a list of 26 titles in *Bio-Science* 20(2):126-127 (Jan. 15, 1970). Since this includes 43 volumes averaging 565 pages each, the guiding comments will be appreciated. This area is one of enormous ignorance in raptor research but of vital importance. Similar lists on various zoological topics are a regular feature of this now twice monthly periodical of the American Institute of Biological Sciences.

Predation Theory. Michael H. Robinson of the Smithsonian Tropical Research Institute (Balboa, Canal Zone) has written a critical review, "Defences against visually hunting predators," published in Volume 3 of *Evolutionary Biology* (N.Y.: Appleton-Century-Crofts, 1969, 309pp., see pp. 225-259). Although the examples used are almost all on predators other than raptors (and on prey not often important in raptor diets, such as stick insects), most of the paper is of general enough significance to be of interest to many of our readers. Much attention is given to antipredator adaptations; perhaps of most interest is his discussion of "prey recognition by visually hunting predators."

Pesticide Series. If our members would like to read a series of five detailed but popular articles on the pesticide situation, they are encouraged to see the magazine *Environment* (11(6):14-40, July-Aug. 1969 and 11(7):2-17, 28-31, 36-40, Sept. 1969). This magazine regularly carries analyses and news on the effects of technology on the environment.

Corrections. R. Wayne Nelson writes that some items in the summary of the NAFA Peregrine Falcon Symposium (*Raptor Research News* 3(4):73-79) might be misleading. He suggests that part 5 be rewritten as follows: "*Queen Charlotte Islands.* W. Nelson reported on this area. He felt the estimate in Hichey's book of 80 pairs was optimistic. Government and falconers' censuses for pairs of birds in 1965, 1966 and 1967 revealed only 43, or, if single birds were assumed to be paired also, then there were 60 pairs."

"Nelson reported that Langara Island, with a 25 mile circumference and about 16 nest sites, contained annually about 12 pairs of Peregrines in the late 1950's. In 1966 it held five pairs and four singles—a possible nine pairs; in 1967, seven pairs; in 1968, five pairs and one single; and in 1969, four breeding pairs, plus two additional pairs which both had immature females and adult males. These immature females showed little territorial impulse. They apparently had no eggs or young. Ancient Murrelet pesticide results suggest that eggs flush DDE, DDT, etc., out of the females, whereas males retain their concentrations. Dry weather at hatching time may kill some chicks in the eggs."

Nelson also noted that Tom Ray acknowledged Dan Anderson as the source of the large number of egg shell thickness measurements, a fact omitted from the summary, and that Ray indicated that the reduction from nestling ratio to fledgling ratio was due to "harvesting" by people.

We look forward to the completion of the proceedings by NAFA in which these and other points should be clarified. We hope these informal summaries serve a useful purpose until the full reports are available. Nelson also commented that the term "mid-latitude Peregrines" changed to "latitude Peregrines" during the course of the meeting. We will await the proceedings to clarify the terminology and its definition.

RAPTOR RESEARCH SURVEY; 1970, No. 1

With the 1970 renewal notices we sent out forms to report titles of current research projects. Those that have been returned so far are listed in this issue of the *News*; we will prepare supplements for subsequent issues. The following symbols are used: **a**—planning; **b**—in progress; **c**—nearly finished; **d**—manuscript; **e**—in press.

Julian L. Ambrus, MD, PhD (143 Windsor Ave., Buffalo, N. Y. 14209): Study of Members of the Fibrinolysin and Blood Coagulation Systems in Raptors (**b**).

Daniel D. Berger (see James Enderson).

I. L. Brisbin, Jr. (c/o AEC-SROO, Bldg. 772-G, Aiken, S. C. 29801): Bioenergetics of Growth in Young Raptors (**b, d**).

Tom Cade (R. D. 1, Dryden, N. Y. 13053): North American Peregrine Survey (**a**).

Ron Collette (1330 W. 4th St., Ontario, Calif. 91762): Breeding Prairie Falcons and Peregrine Falcons (**b**).

Lawrence D. Crowley (756 19th St., Boulder, Colo. 80302): Golden Eagle Nesting Survey (**b**).

Lee A. Eberly (Rt. 2, Box 94, Vermillion, S. D. 57069): Ethology and Ecology of Screech Owls (**b**).

Lon Ellis (950 N. Tropical Trail, Merritt Is., Fla. 32952): Introduction of Red-tailed Hawks as Residents in the Wild; Raptor Management (**b, d**).

James Enderson (Langmuir Lab., Cornell Univ., Ithaca, N. Y. 14850): Pesticides: Egg Shell Thinning and Lowered Production of Young in Prairie Falcons (with Daniel D. Berger) (**e**).

Josephine L. Fernandez (P. O. Box 53, Dartmouth, Mass. 02714): Survey of Osprey of Westport, Mass. (**a**).

G. Michael Flieg (Brookfield Zoo., Brookfield, Ill. 60513): 1) Oral Immobilizing Drugs for Birds of Prey (**b**); 2) Nutrition in Birds of Prey (**e**).

Glen A. Fox (65 Grange St., Guelph, Ontario, Canada): Variations in Reproductive Success, Egg-shell Thickness, and Status of the Merlin, *Falco columbarius* (d).

Edward S. Freienmuth (2408 Delwood Ave., Durango, Colo., 81301): Prairie Falcon Breeding (a).

Lou Gaeta (12686 Auburn Rd., Chardon, Ohio 44024): Work With Golden Eagle (a, b).

Jon Gerrard (3851 University St., Douglas Hall, Montreal 112, Quebec, Canada): A Study of the Bald Eagle in Saskatchewan (b).

James W. Grier (Lab. of Ornithology, Cornell Univ., Ithaca, N. Y. 14850): Bald Eagle Ecology & Behavior (b; parts in various stages).

John Hall (1611 W. 9th, Upland, Calif. 91786): Laggar Falcon Breeding Project (b).

William H. Halliwell (Dept. of Vet. Pathology, Univ. of Missouri, Columbia, Mo. 65201): Marek's Disease and Leucosis Complex in Great Horned Owls (*Bubo virginianus*) (d).

Fran Hamerstrom (Plainfield, Wisc. 54966): 1) Harrier Molt Study (with Wm. Scharf) (c; 11th year of study); 2) Ageing Harris' Hawks (with Fred Hamerstrom) (c; 3rd year of study); 3) Cloacal Sexing of Raptors (with John L. Skinner) (d); 4) The Relationship Between DDT and Changes in Harrier Behavior and Reproduction (with R. Risebrough) (b); 5) Ethology of Golden Eagle (especially breeding attempts and nesting; book—*An Eagle to the Sky*; Iowa State Univ. Press) (e); 6) Effect of Biopsy on Harriers (d; 3 year study); 7) Ageing Red-tailed Hawks (d); 8) Kestrel Nesting Study (b; 3rd year); 9) Data on Development of a young Great Horned Owl (Ambrose *in* Animal Biographies, Victor Cahalane, Ed., Prentice Hall) (e).

Fred Hamerstrom (see Fran Hamerstrom 2).

Donald S. Heintzelman (New Jersey State Mus., Trenton, N. J. 08625): 1) Ecology and Breeding Biology of *Falco sparverius* on the Coastal Plain of Central New Jersey (b); 2) *Autumn Hawk Migration* in Eastern North America (book) (b).

Keith Alan Hodson (5191 Robertson Rd., R. R. 1, Ladner, British Columbia, Canada): Wintering Raptor Populations on the Fraser River Delta, B. C. (c; 2 year study—1968-1970).

P. B. Hofslund (Biol. Dept., Univ. of Minnesota, Duluth, Minn. 55812): Meterological and Geographical Effects on Hawk Migration (b).

M. D. Horton (Rt. 2, Box 293, Vernal, Utah 84078): Facts About Aspergillosis (b).

C. Stuart Houston (863 University Dr., Saskatoon, Sask., Canada): Banding of Great Horned Owl, Swainson's Hawk, Ferruginous Hawk; other Raptors (b, d, e).

Joseph A. Jacobs (1928 Hillcrest Ave., Pennsauken, N. J. 08110): New Jersey Bald Eagles—Ospreys of Seven Mile Beach, N. J. (b).

Donald W. Kaufman (Savannah River Ecology Lab., c/o AEC-SROO, P. O. Box A, Aiken, S. C. 29801): Selection of Mice With Respect to Various Colors of Soil Background by Barn Owls and Screech Owls (b).

Monte N. Kirven (6482 Cardeno Dr., La Jolla, Calif. 92037): 1) Population Survey of Peregrine Falcons in Baja California (b); 2) Breeding Project With *F. p. tundrius* (a).

Calvin Knock (2532 E. Huntington Dr., Duarte, Calif. 91010); Breeding Red Headed Falcons (*Falco chiquera*) (b).

Howard R. Leach (Calif. Dept. of Fish and Game, 1416 9th St., Sacramento, Calif. 95814): Raptor Survey, State of California (a, b).

William Robert Magee (8305 Slough Rd. N.W., Carroll, Ohio 43112): Breeding Red-tailed Hawks (a, b).

Dr. Vic Mankin (College of Education, Univ. of Delaware, Newark, Delaware 19711): Teaching Falcons to Retrieve (1st manuscript in print—*F. C. of A. Journal*, Nov., 1959, Vol. 2, No. 2) (b).

Carl D. Marti (412 Scott Ave., Ft. Collins, Colo. 80521): Some Comparisons of the Feeding Ecology of Four Owls in North-Central Colorado (c).

Kenneth Eric Mesch (Room 3, Andrews Hall, Boulder, Colo. 80302): Behavioral Differences Between Eastern and Western Species of Great Horned Owls (b).

Helmut C. Mueller (Dept. of Zoology, Univ. of North Carolina, Chapel Hill, N. C. 27514) 1) *Falco sparverius*—Laboratory Studies of Prey Selection (b); 2) Relationships of Hunger to Various Predatory Behaviors in *Falco sparverius* (b).

Morlan W. Nelson (73 East Way, Boise, Idaho, 83702): Attempting to Breed Golden Eagles in a Large Outdoor Area (b).

R. Wayne Nelson (Dept. of Biology, Univ. of Calgary, Calgary 44, Alberta, Canada): Breeding Behavior of the Peregrine Falcon (b).

Jack Oar (1603 Log-cabin Ave., Rockford, Ill. 61108): Nesting Census of Red-tailed Hawk and Great Horned Owls in Illinois (a).

Richard R. Olendorff (Aggie Village 7-D, Ft. Collins, Colo. 80521): Growth, Morphology, and Physiology of Three Species of *Buteos* (b).

James W. Parker, Jr. (Museum of Natural History, Univ. of Kansas, Lawrence, Kansas, 66044): 1) Ecology and Population Dynamics of Mississippi Kites (b); 2) Winter Ecology and Behavior of Marsh Hawks (d).

John Edward Polson (2864 West 32 Ave., Vancouver 8, British Columbia, Canada): 1) Observations of Migrating Raptors (*i.e.*, all falcons and accipiters) Through Lower Fraser Delta of British Columbia—Special Reference to Merlin (b); 2) Breeding Project with Prairie Falcon; Use of Artificial Light to Stimulate Breeding Behavior in Non-breeding Season (b).

Sergej Postupalsky (2926 W. 13 Mile Rd., Royal Oak, Mich. 48073): 1) Ecology of Bald Eagle Populations in Michigan (c); 2) The Bald Eagle Population in S.W. Ontario (c); 3) The Bald Eagle Population in the Lake Nipigon Area of Ontario (b); 4) Ecology of the Osprey in Michigan and Ontario (b); 5) Population Changes in Raptors in S.E. Michigan (b).

R. Risebrough (see Fran Hamerstrom 4).

Gerald L. Richards (513 Adams St., Fort Atkinson, Wisc. 53538): Reproductive Behavior of Kestrels Under Confinement (b).

William H. Robinson (R. D. 3, Box 70B, Saugerties, N. Y. 12477): Breeding Eleanora Falcons (b).

James T. Ross (708 Dale Ave., Cumberland, Md. 21502):

Breeding Raptors of Allegany County, Md. (a)

Herman H. Samson PhD (Dept. of Psychology, Arizona State Univ., Tempe, Ariz. 85281): Visual Acuity in Raptors (b).

Wm. Scharf (see Fran Hamerstrom 1).

Jim Scharff (6300 East First, Box 67, Seattle, Wash. 99206): Population Study (b).

Jay H. Schnell PhD (Tall Timbers Research Station, Rt. 1, Box 160, Tallahassee, Fla. 32301): Winter Raptors at Tall Timbers Research Station: Development of a Trap-retrap Technique (b).

John C. Seidensticker (Wildlife Research Unit, Univ. of Idaho, Moscow, Idaho 83843): 1) Nesting Performance and Organochlorine Insecticide Residues in the Red-tailed Hawk and Great Horned Owl of South-Central Montana (d); 2) Response of Juvenile Raptors to DDT in the Diet (d).

Williston Shor (6614 32nd St., N.W., Washington, D. C. 20015): Analysis of Peregrine Falcon Banding Data (d).

Robert W. Simons (3444 N. Church St., Rockford, Ill. 61103): Aspects of Rough-legs Wintering in Illinois and Indiana (a).

John L. Skinner (see Fran Hamerstrom 3).

John Craig Snelling (Lab. of Ornithology, Cornell Univ., Ithaca, N. Y. 14850): Ecology of Eagles and Eagle Owls in the Kruger National Park, Republic of South Africa (c).

Rey C. Stendell (Museum of Vert. Zoology, Univ. of Calif., Berkeley, Calif. 94720): Ecology of White-tailed Kite in the Sacramento–San Joaquin River Delta (b).

David E. Stokes (630 Washington Lane, Jenkintown, Pa., 19046): Goshawk Population of Pike County, Pa. (a, b).

L. G. Swartz (Bunnell Bldg., Univ. of Alaska, College, Alaska 99701): 1) Breeding Biology; populations, with special reference to pesticides, of Merlins (b; 3 years); 2) Captive Breeding of Merlins (b, d); 3) Captive Breeding in Peregrines (b); 4) Interior Alaska Peregrine Survey (b); 5) Varied Ecological Studies (Including Behavior) of Gyrfalcons. (bulk of research being conducted by graduate students) (b); 6) Status of Alaskan Raptors with Respect to Pesticides; species

including Merlin Gyrfalcon, and Peregrine, but to include as complete a spectrum as possible of species breeding in Alaska (b; major emphasis to begin spring 1970).

Stanley A. Temple (Lab. of Ornithology, Cornell Univ., Ithaca, N. Y. 14850): 1) Taxonomy of North American Merlins (c); 2) Population Ecology of the E. Pigeon Hawk (b).

Roger Thacker (Dept. of Animal Labs, Wiseman Hall, Ohio State University, 400 W. 12th, Columbus, Ohio 43210): 1) Internal Parasites of the Red-tailed Hawk (*N.A.F.A. Journal* 1970) (e); 2) Identification and Treatment of Internal Parasites in the Red-tailed Hawk with Special Reference to Fluke Infestation (b).

F. Prescott Ward (Medical Research Lab., Edgewood Arsenal, Md. 21010): 1) Pulmonary Aspergillosis in Prairie Falcon Nest Mates (e; *Bull. Wildl. Dis. Assoc.*, Jan. 1970); 2) Clinical Spiruridiasis in Captive Falcons (d); 3) Parasitisms of Birds of Prey: Diagnosis, Treatment, and Pathogenicity (d).

Clayton M. White (Section of Ecology, Cornell Univ., Ithaca, N. Y. 14850): Ecology of Raptor Populations on Amchitka, Aleutian Isls., Alaska (c)

Jimmie White (5741 Myra St., Cypress, Calif. 90630): Establishing a Breeding Colony of Harris' Hawks (b; 5 years).

David R. Williamson (4328 Lambeth Lane, Ft. Worth, Texas, 76103): Breeding Merlins (a).

Bruce R. Wolhuter (2109 Kentucky, Lawrence, Kansas 66044): 1) Nesting Survey of Great Horned Owls (b); 2) Nesting and Behavioral Study of Mississippi Kites (a).

HEALING OF A SHATTERED WING IN A GYRFALCON

by John Lejeune
6474 Wellington Avenue
West Vancouver, British Columbia, Canada

Until I learned the hard way, I believed that in order to obtain a healthy falcon for my breeding project, it had to be flown to the lure for a certain time. On September 16, 1968, one of my eyass Gyrs was shot by a local farmer and waterfowl enthusiast. Her left wing was shattered in four places (see Figure 3), pellets penetrated her breast muscles from the side in two or three places, and penetrated her left leg just above the foot. Because of the severe loss of blood and the complexity of the fractures, it was decided not to attempt splinting the bones. The wing was taped alone in the manner shown in Figure 1, and then the whole wing was taped against the body as in Figure 2. For most of the time during healing, the two wings were taped together at the tops over the back.

For three weeks the bird was kept in a two foot square box on a block and fed small pieces of meat by hand. During this period, the bird became very thin and developed frounce, which was cured within a few days by one-half of a pill of emtryl. After this period, the wing was deemed sufficiently healed to allow the removal of the tape (see Figure 4).

Within a few days, the bird was able to raise the wing very slowly, and by the beginning of December, it was able to make its first flight of approximately 500 yards. During this period the No. 2 primary dropped out to be replaced by a new one within a month. Today the wing seems fully healed although it is kept in a position lower than normal and cannot be stretched out completely.

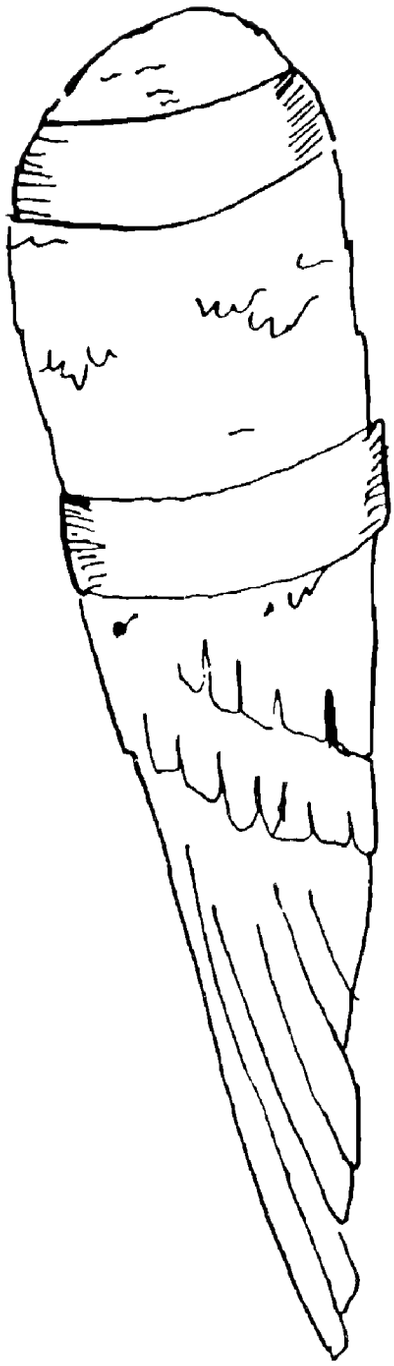

Figure 1. Manner of taping wing of Gyrfalcon.

Figure 2. Manner of taping whole wing against the body of Gyrfalcon.

Figure 3. X-ray of Gyrfalcon wing, taken from below, September 16, 1968. Arrows indicate where pellets penetrated. A, B, D -small lead deposit of pellets. C—pellet embedded in muscle (removed by owner approximately three months later).

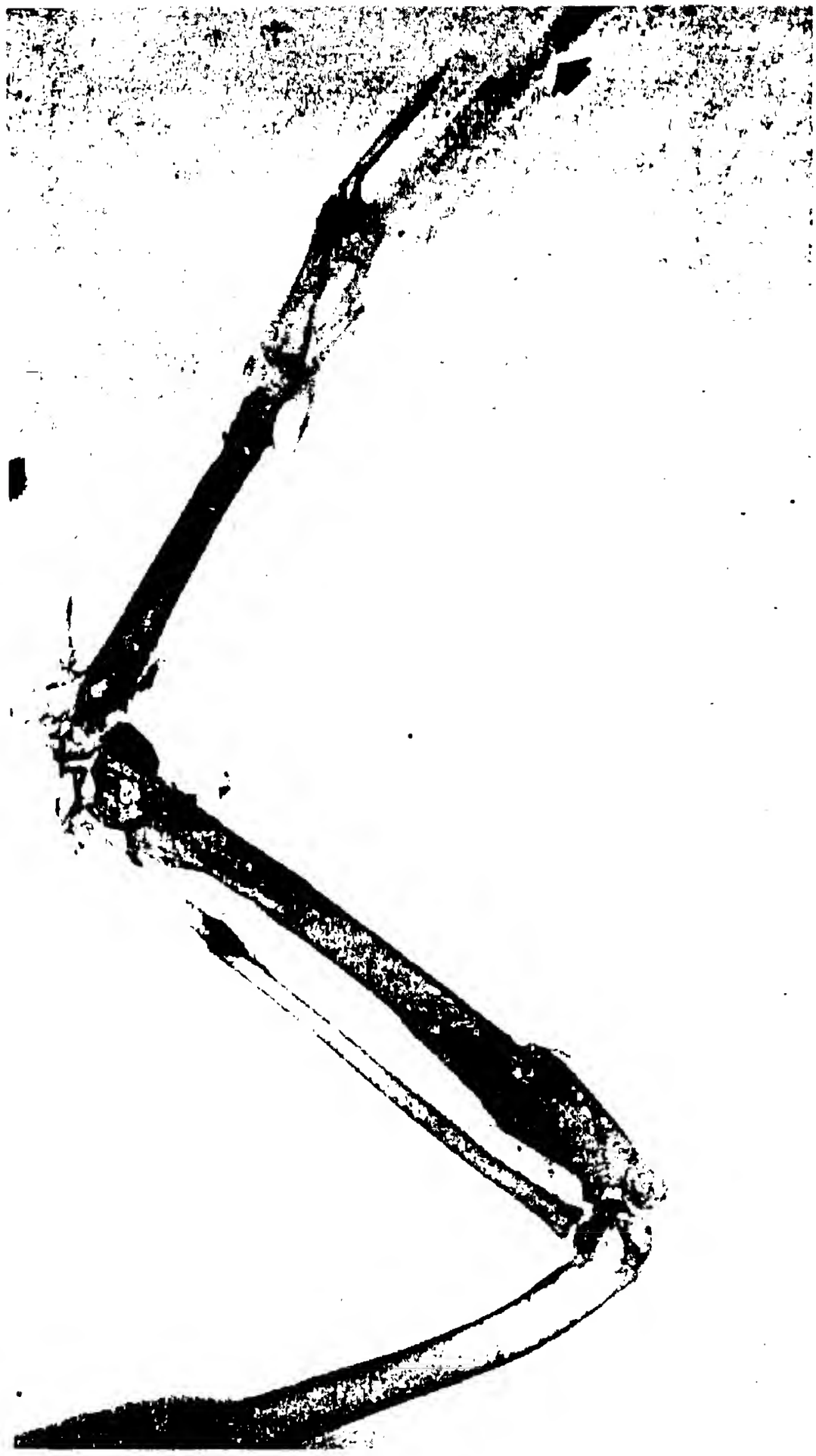

Figure 4. X-ray of Gyrfalcon wing, taken from below in approximately the same position as in Figure 3, December 15, 1968. Arrow indicates incomplete feather in blood.

CAPTIVE BREEDING BEHAVIOR

AMERICAN GOSHAWK – PART 2

by Robert B. Berry
Yellow Springs Road
Chester Springs, Pennsylvania 19425

Part 1 of my experiments with Goshawks appeared in *Raptor Research News*, 2(3):58-97, July 1968. The contents of Part 1 are summarized as follows: Jill, an American hen Goshawk was taken from the nest as a "downy." She was flown in falconry in her first year. As a yearling she exhibited extreme territorialism and was probably sexually mature. Her third year was interrupted by the stress of room construction activities. Jill became very territorial in her fourth spring. She started building a nest immediately after being placed in a suitable breeding chamber. All attempts to introduce her to a wild trapped male Goshawk were futile and it appeared she accepted me as a mate. Jill laid four infertile eggs and sucessfully fledged a Red-shouldered Hawk.

Late in November of 1966, I met with Frank Beebe of Saanichton, British Columbia, and arranged to borrow his adult male Goshawk, Fritz, a European eyas in his twelfth year. He had been flown in falconry off and on for those many years and proved an exceptional game hawk. He was, however, of independent character, given to extensive hunting on his own which made practical falconry very difficult.

Mine was not the first attempt to breed Fritz. Two years earlier he had been introduced to a first year haggard Swedish hen. They were tethered on lawn perches and fed from a common block placed mid-way between them. It appeared that a pair bond was established in this manner. When they were placed in a breeding chamber, one or both birds constructed a rudimentary nest. The project was unfortunately interrupted by the premature death of the hen.

Fritz arrived on December 12, 1966. He was a beautiful grey brown European Goshawk with a well defined eye stripe and broad dark horizontal barring on the breast. He weighed 28 ounces and was a compact bundle of wild muscle and energy. Jill weighed approximately 36 ounces.

On December 14, I placed Fritz in the inside chamber which joined the outside pen (see Figure 1). All windows were darkened except one. Perches were arranged on each side of the open window so that the hawks, separated by one inch mesh plastic wire, could virtually touch one another. Fritz sat at the window, but Jill seemed

unaware of the stranger.

The first few days passed without incident, so I brought Jill inside to eat with Fritz. She immediately left her food and attacked, chasing him about the room. After the fourth such onslaught, he held his ground, standing straight and tall and appearing very large indeed. Jill back peddled in mid-air and the chasing ceased. Fritz acted as I had hoped, and I was much encouraged. The door was opened allowing free passage for both hawks to the inside and outside chamber.

The first week passed with relative calm. Except when feeding, Fritz spent all of his time inside the semi-darkened chamber. Jill remained outside, so there was little opportunity for social interaction.

Both birds were fed a diet of chicken heads, fresh pigeon and an occasional pheasant. All feeding was carried out under cover of darkness. If the evening was warm and the meat would not freeze, it was allowed to remain to be consumed at dawn. On cold nights, the pen was illuminated at varying intervals from one to three hours after depositing the food. The purpose of the night feeding was two fold: 1) Fritz was extremely shy and upset when approached during day light hours and 2) I hoped that Jill would not associate my presence with feeding time. I hoped that varying the time interval prior to illumination would further disguise any link between myself and feeding.

Late in December Jill's placid behavior changed radically. She called wildly, worked on her nest, and was extremely aggressive towards Fritz. Thinking that her nest might be a stimulus to aggression, I removed the entire platform. Her hostility continued. Fritz was totally unable to cope with her and behaved in exactly the same manner as the prior male (see *Raptor Research News*, 3:69, 1968). Compatibility on such short notice was obviously wishful thinking.

On January 1, I chased both birds into the darkened inside chamber and closed the door. For the next few days I worked feverishly to install a wire partition dividing the outside chamber into equal parts. Jill would have access to the inside shelter and adjoining outside area. Fritz was confined to the extreme outer portion and was provided an enclosed ceiling and wind break in one corner (see Figure 1). He could no longer escape to the inside chamber, and I hoped that in the next few months he would become acclimated to the new environment and would establish a territory of his own. Jill was forced to observe Fritz occupying her favorite perches and would perhaps become accustomed to his presence. A common nest site, a wire basket with elevated sides, was erected so that it extended into both chambers.

Initially, Fritz sulked on the lowest corner perch, the same perch

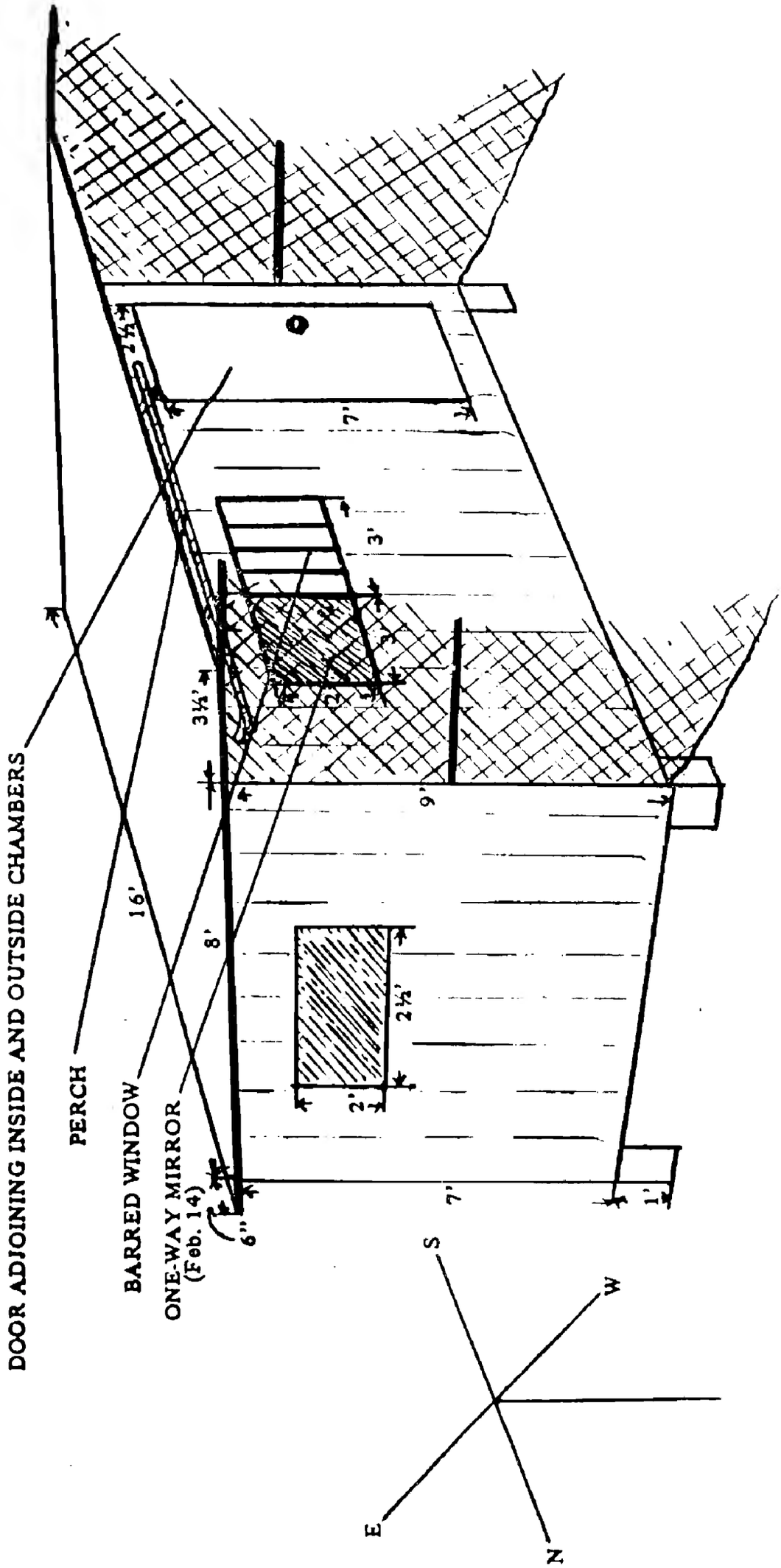

Figure 1a. Breeding Chambers (Inside Chamber).

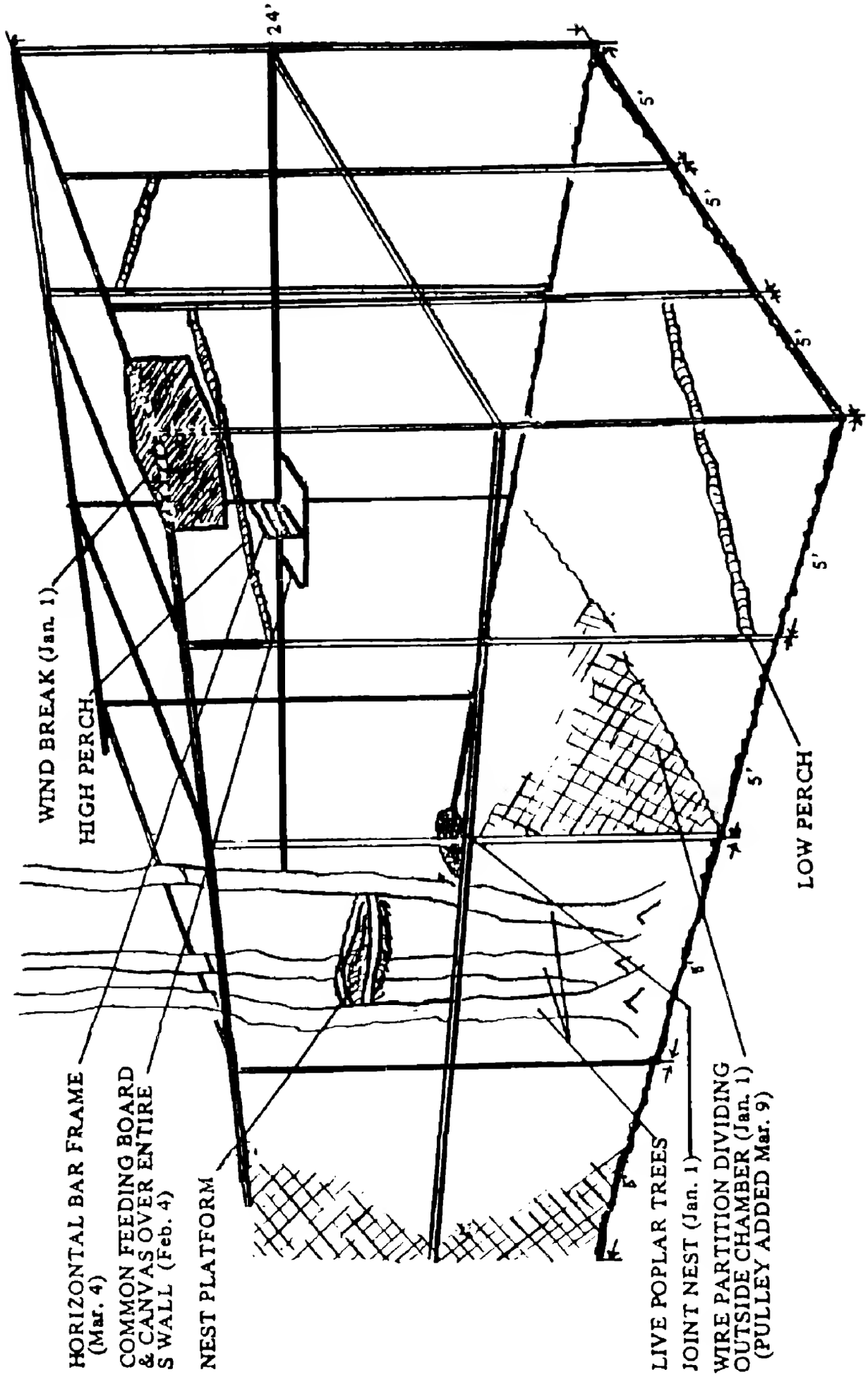

Figure 1b. Breeding Chambers (Outside Chamber).

favored by the prior male. Within the next ten days, however, he began to utilize the medium and high perches and by the middle of the month he actually tried to attack Jill. By the end of January, he appeared a self-assured and dominant Goshawk. Jill, on the other hand, appeared nervous and flew incessantly at the wire divider. Her behavior was not aggressive and she was strangely silent. When she fluttered against the divider, he attacked and tried to grab her through the wire. He even developed his own hoarse "kac kac kac." Jill was obviously frightened and I was beginning to have doubts about re-introduction. I felt I knew Jill's propensities for homocide, but Fritz was an unknown entity.

According to the Weather Bureau, the final week of January was the warmest ever recorded, with the temperature zooming into the seventies for practically a full week. Jill reacted vocally and began to carry an occasional stick to the joint nest. Once I saw Fritz take a piece of bark in his beak to the lower perch, but he displayed no interest in the common nest bowl.

On the evening of February 3, I replaced Jill's tree nest, lowered the barrier and turned on the lights. They had been separated by the thin wire divider for thirty-two days. Fritz seemed ready to cope with Jill's aggression. He flew almost immediately to the tree nest and chirped in an unfamiliar manner. She flew to a high perch and was otherwise unconcerned. He chased her briefly, flew to a perch of medium height, and both settled for the night.

At dawn the next morning, Fritz flew directly to the tree nest and made a series of sharp chirps accompanied by a bowing of the head with raised tail and flashing undertail coverts. His behavior seemed either sexually or territorially motivated and, excepting the chirping, similar to the female's gestures. Jill's approach was cautious, almost as if she expected trouble. Fritz reacted violently and attacked her. She retreated to a high perch and he flew directly to his accustomed low perch in the far corner of the pen. It appeared that he had lost his courage.

There was little activity until about 1:00 P.M., when Fritz flew to the nest, chirped, flew at Jill, and then withdrew to his corner and sulked. Now Jill began to scream and to carry sticks. By late afternoon, she was as hostile and aggressive as ever and Fritz just as frightened. The following morning was worse and I raised the barrier once more.

In just a few short hours, Jill had completely regained her superiority and once again exhibited extreme aggression in defense of territory. Fritz's brief interval of dominance had come to an end, and he appeared positively terrified of his antagonist.

Fritz continued to be extremely shy and flew frantically about his quarters at the slightest glimpse of human activity. Jill's aggression appeared to be stimulated by this fear. I suspect that poor Fritz felt

both human and hen Goshawk were involved in one big plot against him, no joke intended! This behavior did suggest possible benefit if human interference could be reduced.

For the second time, both hawks were herded into the darkened inside shelter for major alterations on the breeding chambers. I completely covered and blocked off the south side of the chambers with a large heavy canvas. All visual contact with people was now effectively eliminated. I also installed a common feeding board directly behind the canvas. A small trap door in the center of the canvas facilitated placement of food, which was secured to the feeding board by dog leash clips. Neither bird could carry food from the platform and close interaction was mandatory at least while feeding. Finally, for watching I placed a large one way plastic mirror (from Edmund Scientific Company of Barrington, N. J.) over one window of the enclosed chamber. Now I could approach the chambers at any time of day and make observations from only a few feet away without being detected.

During the following weeks, Fritz would not leave the lowest perch. Even though protected by the wire divider he panicked at Jill's hostile screaming or at her slightest aggressive movement. His only refuge appeared to be the ground or the low perch-stations which would appear to me to place the dominated partner in the most vulnerable position.

On February 11 I removed the nesting platform--the nucleus of Jill's territory--hoping to decrease her aggression, but hostility continued. Before taking down the platform, I had first to remove Jill from her perch almost directly above the nest. In spite of no contact whatsoever with me for the past six weeks, Jill was completely tame. Any ostriger who has placed a Goshawk in solitary moult can attest, this is most extraordinary behavior for the species.

Towards the end of February, Fritz began to relax and to utilize the high perches in his chamber. Soon he was screaming sporadically and making mock attacks at Jill. Jill appeared frustrated and nervous with little purpose to her existence as she seemed psychologically unable to build effectively in the joint nest. She was neither vocal nor hostile towards Fritz.

On March 4, Fritz was seen carrying a stick to the feeding block—not to the joint nest bowl. Soon a second stick was found on the platform. Immediately, and again under the illusory cover of darkness [Jill appeared capable of recognizing me as opposed to strangers on the darkest of nights], I installed a rectangular frame about one by two feet long with thin stainless horizontal bars spaced three inches apart, which replaced the wire section in the middle of the feeding platform. The widely spaced bars would allow Jill to seize any sticks deposited on the platform. I even lodged a few sticks in the bars, but Jill never used them even though any sticks hanging

in the wire had been eagerly accepted the year before.

It is significant to note that during the next few weeks, Fritz made no further attempt to carry sticks. I do not feel that the horizontal bar framework in lieu of the wire division discouraged Fritz, nor did my activity associated with its erection. Stick transfer may well have been the catalyst necessary to stimulate establishment of the normal pair bond relationship.

Mid-March was approaching and I was becoming increasingly frantic. A year ago at this time, Jill has a mammoth nest, and was apparently paired with me. This year her sexual development was retarded to the point of almost total sexual quiescence. Fritz now appeared confident while behind the wire divider. He had displayed aggression towards the hen, called occasionally the "kac kac kac" of the territorial Goshawk, and had carried at least two sticks to the common feeding platform. Their behavior was far from encouraging.

Admittedly groping for alternatives, I decided to install a pulley arrangement to raise and lower the wire divider. The antagonists could now be together for controlled periods—namely in the late afternoon preceding feeding time. I could separate them in the early mornings when Jill had always been most aggressive.

This scheme worked well for the first few days. Once the barrier was lowered, Fritz generally assumed a position on a middle or low perch with Jill perching in apparent contentment well above him. There was occasional sparring, but the situation was far from intolerable. Shortly after dark, food was deposited on each side of the lowered barrier. Without exception, the hawks flew to their accustomed feeding stations and the barrier was raised until the following afternoon. The program was abruptly discontinued when Jill learned to push her way through the unfastened edges of the wire divider. The brief use of her favorite high perches had kindled her desire to regain them permanently. The pulley arrangement was a failure without major alterations. The barrier would either have to be fixed or discarded.

Early in the evening on March 12, I hustled both hawks from the outside pen into the illuminated inside chamber and turned off the lights. The stage was set for the last of many physical modifications to the breeding pen. I removed the wire divider completely and hung freshly cut eight to ten foot tall white spruce trees throughout the chamber. The spruces were arranged to provide protection for Fritz, the male and naturally the smaller. I thought they might create avenues of escape and hiding places.

At the outset, hostility was moderate. In the days to follow, however, Jill's now familiar pattern of ever-increasing aggression began. Slowly at first she approached Fritz, with characteristic hunched shoulders and flaring undertail coverts. Her attacks were encouraged and sustained by his increasing escape behavior.

In an effort to re-direct Jill's aggression, I placed two live guinea hens in the breeding chambers. I had recently observed Jill's hostility toward the dozen or so guinea fowl which parade about the property. The next evening, one was dead and partially eaten. Although Jill had been aggressive towards the guineas, I suspect that Fritz, the seasoned hunter, was responsible. Another hen was added and within a few days, they were roosting side by side with the Goshawks, apparently completely ignored.

Jill became so aggressive the last days of March and early April that on April 9, 1967, I felt that it would be best to remove Fritz permanently from the breeding chamber. My primary concern was that he would injure himself in his frantic efforts to escape.

Stangely enough the spruce trees were of little value for hiding or in facilitating successful escape tactics. I had heard that the Germans installed boxes in their aviaries with holes large enough to accommodate the male goshawk and not the female: the male would flee into a box and find complete sanctuary, only emerging when the hen was in better humor. I have never been able to confirm the authenticity of these reports and seriously question their validity. Not once was Fritz observed within the thick foliage of a spruce tree. Fritz did to an increasing degree utilize those perches that were partially obscured by the spruce trees. Ironically, however, he preferred a station which was unprotected, apparently to provide a number of alternative escape routes.

Final separation of the Goshawks, and dissolution of any further attempts toward natural breeding, was my emotional reaction to a particularly dreadful series of attacks. I rushed into the pen in broad daylight with full intent to chase Fritz once and for all into the inside chamber. As I climbed to the medium perches at the far end of the pen, Jill was screaming and displaying with, I thought, sexual intent. I could not have been further mistaken. I was met head on by a maniacal Goshawk and eight needle sharp talons that felt more like ice-picks. I managed to save my face only by sacrificing my arm to her attack. Jill would not relax her initial grasp and hung tenaciously while I extracted her talons one by one. At last I retreated in pain with one eye on Jill and my arms covering my head. Fritz had long since beat it to the inside chamber.

The next few days were spent converting the breeding chamber to its status quo, *e.g.*, removing the canvas tarp, the wire divider, the joint nest, the common feeding platform, the spruce trees and finally re-installing the natural tree nesting site. During this period, the Goshawks were in the darkened chamber.

On April 11, Jill was permitted access to her once familiar open chamber and nesting platform. She was noticeably more at ease. She no longer flew nervously from perch to perch and into the vertical sides of the pen. Within a few days, she was productively

constructing her nest—a process she had been unable to handle all spring. I suspect her contentment can be largely attributed to resumption of familiar surroundings and Fritz's absence.

On April 15, I had time for watching so I opened the door separating the Goshawks' respective chambers. Jill inspected the inside chamber only once, but even though Fritz remained in the semi-darkened chamber, her attitude changed. She stopped constructive nest building and literally destroyed the entire nest she had worked so diligently to create the past week. She kept carrying new sticks to the platform, but in the process of re-arranging sticks, large quantities of nesting material were dropped. Soon I closed the door between the chambers and within hours Jill resumed normal nest construction. Jill appeared incapable of carrying out productive nesting activity while subject to the stress of territorial defense.

Toward the end of April, it became increasingly obvious that Jill's display was no longer oriented towards aggression—at least as far as I was concerned. Whenever I approached, the aggressive vertical defense posture (see Figure 4 in Part 1) changed to a horizontal posture, with head down and wings slightly extended. Her defensive "kac kac kac" modulated to a soft cluck, similar to that of a mother hen with chicks. She tore at bits of spruce bark and allowed them to float to the ground below. Her undertail coverts were fanned in brilliant pre-copulatory display. When I laid my hand gently on her back, she cocked her tail to one side and separated her panel feathers. Her oviduct protruded from the cloaca, extending and retracting rhythmically. Throughout the ritual, she called softly. When I retired from the pen, she appeared revitalized, and began working on her nest with renewed vigor. I am quite certain that as far as Jill was concerned, her sexual needs for nesting had been completely fulfilled.

On May 9, with Ryan Walden's assistance, I made a vain attempt to secure semen from Fritz. Ryan had had some experience with chickens, as had I, but neither of us could be classified as experts—a must in my opinion. We had little difficulty in getting Fritz to prolapse and a rather poorly developed penis (in comparison to sexually mature chickens) was easy to locate. Stroking of the back, after perhaps five minutes, produced involuntary convulsions of the body with both wings and leg muscles contracting sharply. He seemed mesmerized and required little restraint other than to facilitate the stroking. When no semen was ejaculated, we allowed him to rest awhile and then tried again. Our second and last attempt was also in vain and this time failed to produce the convulsions too.

A. J. Marshall's *Biology and Comparative Physiology of Birds*, Volume II, indicates that the process of maturation of the male gonads in birds is a complex and lengthy process brought about by a combination of external stimuli, including photoperiod, weather,

territory, and absence of stress. While Fritz was certainly a mature hawk at 12 years of age, under the circumstances, I feel safe in stating that he was not fully developed sexually.

On May 11, Jill laid her first egg. As in the previous year, it was dropped from a high perch, probably during the night. On May 13, the second egg was laid—this time in the nest. Incubation began immediately. Three days later, the third and final egg came and incubation continued with the two egg clutch. Again Jill experienced a dramatic weight reduction during laying and drank vast quantities of water. She was not inclined to eat by herself and had to be hand fed. However, during this entire period and for about a week following her final egg, Jill appeared eager to copulate. Her behavior suggests that feeding of the female by the male may be encouraged by an ability to copulate well beyond the time period necessary to achieve maximum fertility. Once laying was complete, Jill seemed quite capable and willing to feed herself.

My efforts to introduce an adult male Goshawk to Jill's chambers had been in vain for the past two seasons. Jill appeared irreversibly mated to me and was hostile towards every other living creature—with one exception: Jill had lived in complete harmony with the young Red-shouldered Hawk she had raised the year before. I began searching for a Goshawk nest. I theorized that familiarity and uninterrupted association with her own adopted offspring might inhibit Jill's aggression. It also seemed likely that a male raised in this manner would have absolutely no fear of his parent. Once the male reached maturity, a natural conclusion to a close association might be the establishment of a pair bond relationship.

On June 4, Jill was introduced to a tiny male Goshawk chick, which was a week old at the very most. Incubation had been uninterrupted for the past several weeks and she accepted the youngster without hesitation. I am exceedingly grateful to Ryan Walden and Roy Froch for contributing the young Goshawk.

Jill treated the fledgling as she had the Red-shouldered Hawk. On July 4, 1967, the day I left for the Yukon Territories, Jill was a completely devoted parent. The youngster was flying about the pen and would be hard summed in two weeks. For his age, he appeared far more advanced than the Red-shouldered Hawk and pursued Jill aggressively for food. He was somewhat nervous, but tame enough to allow me to enter the breeding chamber and to photograph him.

Jill's aggression toward intruders continued at a high peak, contributing to a tragic accident. I had made arrangments with Frank Beebe to return Fritz personally to Vancouver, B.C., on my way to the Yukon Territories. The afternoon before I was scheduled to depart, I took Fritz from his mews and placed him temporarily in the semi-darkened chamber next to Jill's perch. Fritz was hooded in preparation for the trip. When I returned a few moments later, I was

horrified to find Fritz lying on the floor mortally wounded. Jill had entered the chamber through a small hole for photography that I had neglected to cover the day before.

Conclusions–Part 1 and Part 2

The theme of my breeding project with Goshawks centers around Jill and efforts to encourage a normal pair bond relationship with a male of her species. I have attempted to utilize certain behavioral patterns identified and analyzed by Konrad Lorenz in his book *On Aggression*, (1966, N.Y.: Harcourt, Brace). To paraphrase Dr. Lorenz, the steps to establishment of the pair bond relationship in aggressive animals are as follows:

1) Establishment of territory by either male or female.
2) Trespassers (intraspecific) are aggressively pursued in defense of territory.
3) A *coyness* behavior is exhibited by the pursued individual–coyness being a mixture of the sex drive and the stimulus to flee–inhibiting aggression.
4) The pursued may leave the territory but will return and through habituation, aggression will subside.
5) Acquaintanceship will further reduce aggression and allow the sexual motivation to take over–hence the pair bond formation.

Jill has certainly performed steps 1 and 2–that of establishing and defending territory. Why does Jill remain so aggressive even after lengthy acquaintanceship? Why are the males so terrified of the female of their species? Does the problem lie with Jill, her potential mate, or both?

It has often been suggested that I set up a male Goshawk in a separate breeding chamber, allow him to establish a territory and then introduce Jill. This suggestion is based on the idea that in many species of birds, the male of the species is the dominant partner, assuming the role of territory defender, family provider, and protector. To assume an analogous behavior on the part of a Goshawk or for any raptor appears to be unsound. If we can accept a high level of mortality in raptors and a high rate of re-nesting in the same locale, it follows that both sexes must be capable of defending territory and playing the dominant role in pair bond formation.

During his field studies on wild Goshawks, Dr. Heniz Meng (personal communication) received the distinct impression that the female is the dominant partner in the nest locale. She builds the nest, broods the eggs, feeds the young and defends the territory with little assistance from the male. He appears, in fact, frightened of her at the

nest site. Food transfer is accomplished at a considerable distance from the nest. Dr. Meng has not observed Goshawk copulation and can only assume that it occurs at a similar distant point.

Breeding projects with Goshawks in Europe have met with failure like mine. The female Goshawks were highly aggressive, laid infertile eggs in captivity, and raised adopted young while remaining completely hostile toward their terrified potential mates (J. Mavrogordato, personal communication). While far from conclusive, the evidence does indicate a regressive role as normal for the male Goshawk.

Assessments of individual Goshawk behavior are both difficult and speculative. The wild trapped yearling male in Part 1 showed primarily fear. It is significant to note that his fears were far more acute towards Jill than toward human beings. His only sanctuary was the lowest perch or the ground, a position seemingly offering the most vulnerability. The wailing and prostration of the male appeared to be a ritual designed to reduce intraspecific aggression.

Fritz was an intermewed eyas with a long and varied career in captivity and might have been expected to exhibit a more normal Goshawk behavior. He was, however, excitable and nervous, which is characteristic of the species. He relaxed only when all human interference was effectively eliminated.

Fritz's behavior suggested that he did develop sexually even though I was unable to secure semen artifically: while separated by the wire divider, Fritz gradually lost his fears and became aggressive towards Jill. He even developed the "kac kac kac" of the territorial Goshawk. His mock attacks became so vicious in early February that he appeared dominant and in possession of territory. The bowing and chirping immediately after re-introduction were certainly sexually motivated. It seems incredible that the gradual build up of self-confidence over a period of up to six weeks could be dashed to shear terror in only a few moments. He appeared acutely aware that the wire divider had been removed. Were his fears a product of memory rather than current hostility? Jill always reacted rather slowly and became overly aggressive only when encouraged by escape tactics of the frightened male. I feel certain that a more courageous male would sublimate her aggression as during her initial meeting with Fritz. Unfortunately, however, Fritz followed the pattern of his fearful predecessor in subsequent encounters.

In retrospect, it may have been presumptuous to expect Fritz to adapt completely to new surroundings in a few short months and to behave like a sexually mature adult Goshawk. It is also possible that the size of the breeding chamber was insufficient to accommodate normal breeding behavior for this species. Indeed it is conceivable that the responsibilities of raising a family are sharply divided between male and female with nearly all social interaction taking

place beyond the perimeter of an invisible boundary rigidly enforced by the female. Lastly, it is entirely possible that the original premise upon which Part 2 of these experiments are based is false: the European male Goshawk may not be close enough genetically to allow pair bond formation with an American hen Goshawk.

An analysis of Jill's aggressive behavior towards the male of her species is as inconclusive and paradoxical as my attempts to evaluate the behavior of her potential mates. As the prime subject of this paper, Jill has proved a mystifying subject. It must first be recalled that Jill was taken from the nest as a "downy" and raised entirely by hand in close association with people. One would therefore assume that Jill is imprinted - the concept of imprinting defined by *Random House Dictionary* as "learning occurring rapidly and very early in life, characterized chiefly by resistance to extinction or forgetfulness." Simply stated, she thinks she is either a human being or that all people are Goshawks. However, experiments with young Mallard ducks (E. H. Hess, 1957. Effects of meprobamate on imprinting in waterfowl. *Ann. N. Y. Acad. Sci.* 67:725-732) indicate that imprinting is at its strongest at between 13 and 16 hours of life, during which time Jill was with her parents. The resulting paradox can be explained as Jill is altricial and not nearly as advanced at a given age as the precocial subjects. It is not unreasonable to suspect that imprinting of raptors at a more advanced stage which would roughly coincide with the development of the precocial youngster.

A number of observations on the other hand, appear to question the validity of Jill being imprinted on human beings. If Jill did not recognize the male Goshawk as one of her species either by memory or instinct, it is questionable that the appeasement ceremony as portrayed by the male would inhibit her aggression and save his life. Furthermore, when guinea hens were introduced as an aggression diverting strategem, Jill was most aggressive towards them and may have killed one. Mere acquaintanceship, however, so inhibited her aggression that within a week the guinea hens were totally ignored even while roosting on Jill's favorite perches. If Jill can learn to accept the interspecific guinea hen, why then is she so intolerant of the male Goshawk? It would appear she is acutely aware that she and the male Goshawks are of the same species.

Lorenz says that imprinting is extraordinarily rigid and long lasting, but subsequent research indicates it is not irreversible (Thompson, A. L., Ed., 1964, *A New Dictionary of Birds*. N.Y.: McGraw-Hill, 393 pp.). Lorenz's imprinted geese have never mated successfully but through habituation have developed their own triumph ceremony and pair bond. Carl Welty in *The Life of Birds* (1962, Philadelphia: W. B. Saunders, 546 pp.) recounts on an imprinted male Tiger Heron to have successfully mated in the Amsterdam Zoo. The heron remained faithful to his species only so

long as his keeper kept his distance. Henry Kendall's female Prairie Falcon "Taka" which successfully raised young in 1968 appears to be at least partially imprinted to humans. She performs the same pre-copulatory gestures for Henry as for the tiercel of her kind. Either her imprinting or the wrong conditioning may be responsible for her hostility toward her natural mate in the spring of 1969.

The process of imprinting is not yet fully understood and its relationship with other forms of learning, *e.g.*, habituation and conditioning, are difficult for the layman to separate. I am undoubtedly generalizing and using the term imprinting too loosely.

I think it is safe to assume that Jill is to some degree imprinted on human beings. Her pair bond relationship with me has been further reinforced by two successful nesting seasons. She may, however, just be *conditioned* to respond to human beings, and the problem now lies in evolving a technique that will enable her to take the next step in establishing the normal pair bond—that of living in harmony with her prospective mate. Experience with the young Red-shouldered Hawk in Part 1 indicates that she may not become aggressive towards her young male Goshawk—the subject of Part 3 in this paper.